

CLAIMS

We claim:

1. A process for depositing a thin film on a substrate, comprising:
 - 5 (a) placing said substrate in a process chamber;
 - (b) evacuating said process chamber;
 - (c) introducing a flow of a first reactant gas in vapor phase into said process chamber, said first reactant gas forming an adsorbed saturated layer of
 - 10 said first reactant gas on said substrate;
 - (d) evacuating said process chamber;
 - (e) exposing said substrate to a flux of ions for inducing a chemical reaction of said adsorbed saturated layer of said first reactant gas to form said thin
 - 15 film; and
 - (f) evacuating said process chamber.
2. The process of Claim 1, further comprising repeating said acts (c) through (f) to form multiple layers of said thin film.
- 20 3. The process of Claim 1, further comprising:
 - (g) introducing a flow of a second reactant gas in vapor phase into said process chamber before said act (e).
- 25 4. The process of Claim 3, wherein said exposing said substrate to said flux of ions induces a chemical reaction of said adsorbed saturated layer of said first reactant gas and said second reactant gas for forming a compound thin film.

5. The process of Claim 3, further comprising repeating said acts (c) through (f) to form multiple layers of said thin film.

6. The process of Claim 3, further comprising:
5 evacuating said process chamber between said acts (g) and (e).

7. The process of Claim 1, further comprising after said act (f):

10 (g) introducing a flow of a second reactant gas in vapor phase into said process chamber;

 (h) exposing said substrate to a flux of ions for inducing a chemical reaction of said adsorbed saturated layer of said first reactant gas and said second reactant gas to form a compound thin film; and

15 (i) evacuating said process chamber.

8. The process of Claim 7, further comprising repeating said acts from (c) through (i) to form multiple layers of said thin film.

9. The process of Claim 7, further comprising:
20 evacuating said process chamber between said act (g) and (h).

10. The process of Claim 1, wherein said flux of ions comprises inert gas ions.

11. The process of Claim 10, wherein said inert gas
25 ions comprises argon ions.

12. The process of Claim 1, wherein said flux of ions comprises reactive gas ions.

13. The process of Claim 12, wherein said reactive gas ions comprises one, or more, of nitrogen, oxygen, or hydrogen ions.

14. The process of Claim 1, wherein said flux of ions
5 is generated by impact ionization.

15. The process of Claim 1, wherein said flux of ions is generated using a plasma discharge.

16. The process of Claim 1, wherein said flux of ions is generated in said process chamber.

10 17. The process of Claim 1, wherein said flux of ions is generated spaced apart from said process chamber.

18. The process of Claim 1, wherein said flux of ions is generated in close proximity to said substrate.

15 19. The process of Claim 1, wherein said flux of ions is generated spaced apart from said substrate.

20. The process of Claim 1, further comprising:
heating said substrate to an elevated temperature after said act (a).

20 21. The process of Claim 20, wherein said elevated temperature is between 50 °C to 400 °C.

22. The process of Claim 1, wherein said process chamber is a chemical vapor deposition reactor.

23. The process of Claim 1, wherein said process chamber is operated at a pressure lower than about 10 torr.

25 24. A process for depositing a thin film on a substrate, comprising:

(a) placing said substrate in a process chamber;

- (b) evacuating said process chamber;
- (c) introducing a flow of a first reactant gas in vapor phase into said process chamber, said first reactant gas forming an adsorbed saturated layer of said first reactant gas on said substrate;
- (d) evacuating said process chamber;
- (e) exposing said substrate to a flux of ultra-violet radiation for inducing a chemical reaction of said adsorbed saturated layer of said first reactant gas to form said thin film; and
- (f) evacuating said process chamber.

25. The process of Claim 24, further comprising repeating said acts (c) through (f) to form multiple layers of said thin film.

- 26. The process of Claim 24, further comprising:
 - (g) introducing a flow of a second reactant gas in vapor phase into said process chamber before said act (e).

27. The process of Claim 26, wherein said exposing said substrate to said flux of ultra-violet radiation induces a chemical reaction of said adsorbed saturated layer of said first reactant gas and said second reactant gas for forming a compound thin film.

28. The process of Claim 26, further comprising repeating said acts (c) through (f) to form multiple layers of said thin film.

29. The process of Claim 26, further comprising:
evacuating said process chamber between said acts (g) and (e).

30. The process of Claim 24, further comprising after said act (f):

(g) introducing a flow of a second reactant gas in vapor phase into said process chamber;

5 (h) exposing said substrate to a flux of ultra-violet radiation for inducing a chemical reaction of said adsorbed saturated layer of said first reactant gas and said second reactant gas to form a compound thin film; and

10 (i) evacuating said process chamber.

31. The process of Claim 30, further comprising repeating said acts from (c) through (i) to form multiple layers of said thin film.

32. The process of Claim 30, further comprising:
15 evacuating said process chamber between said act (g) and (h).

33. The process of Claim 24, wherein said flux of ultra-violet radiation is generated by black body radiation.

34. The process of Claim 24, wherein said flux of
20 ultra-violet radiation is generated using a plasma discharge.

35. The process of Claim 24, wherein said flux of ultra-violet radiation is generated using lasers.

36. The process of Claim 24, further comprising:
25 heating said substrate to an elevated temperature after said act (a).

37. The process of Claim 36, wherein said elevated temperature is between 50 °C to 400 °C.

38. The process of Claim 24, wherein said process chamber is a chemical vapor deposition reactor.

39. The process of Claim 24, wherein said process chamber is operated at a pressure lower than about 10 torr.

5 40. A process for depositing a thin film on a substrate, comprising:

- (a) placing said substrate in a process chamber;
- (b) evacuating said process chamber;
- (c) introducing a flow of a first reactant gas in
10 vapor phase into said process chamber, said first
reactant gas forming an adsorbed saturated layer of
said first reactant gas on said substrate;
- (d) evacuating said process chamber;
- (e) exposing said substrate to a flux of
15 electrons for inducing a chemical reaction of said
adsorbed saturated layer of said first reactant gas to
form said thin film; and
- (f) evacuating said process chamber.

41. The process of Claim 40, further comprising
20 repeating said acts (c) through (f) to form multiple layers
of said thin film.

42. The process of Claim 40, further comprising:
 (g) introducing a flow of a second reactant gas
in vapor phase into said process chamber before said
25 act (e).

43. The process of Claim 42, wherein said exposing
said substrate to said flux of electrons induces a chemical
reaction of said adsorbed saturated layer of said first
reactant gas and said second reactant gas for forming a
30 compound thin film.

44. The process of Claim 42, further comprising repeating said acts (c) through (f) to form multiple layers of said thin film.

45. The process of Claim 42, further comprising:
5 evacuating said process chamber between said acts (g) and (e).

46. The process of Claim 40, further comprising after said act (f):

10 (g) introducing a flow of a second reactant gas in vapor phase into said process chamber;
 (h) exposing said substrate to a flux of electrons for inducing a chemical reaction of said adsorbed saturated layer of said first reactant gas and said second reactant gas to form a compound thin film;
15 and
 (i) evacuating said process chamber.

47. The process of Claim 46, further comprising repeating said acts from (c) through (i) to form multiple layers of said thin film.

20 48. The process of Claim 46, further comprising:
 evacuating said process chamber between said (g) and (h).

49. The process of Claim 40, wherein said flux of electrons is generated by a hot filament.

25 50. The process of Claim 40, wherein said flux of electrons is generated using photoelectric effect.

51. The process of Claim 40, wherein said flux of electrons is generated using plasma discharge.

52. The process of Claim 40, further comprising:

heating said substrate to an elevated temperature after said act (a).

53. The process of Claim 52, wherein said elevated temperature is between 50 °C to 400 °C.

5 54. The process of Claim 40, wherein said process chamber is a chemical vapor deposition reactor.

55. The process of Claim 40, wherein said process chamber is operated at a pressure lower than about 10 torr.